CALIBRATION STANDARD SPECIFICATION

FOR AN

OSCILLOSCOPE CALIBRATOR

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PROCUREMENT PACKAGE

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CALIBRATION STANDARD SPECIFICATION FOR AN OSCILLOSCOPE CALIBRATOR

1. SCOPE

1.1 Scope. This specification defines the mechanical, electrical, and electronic characteristics for an Oscilloscope Calibrator. This equipment is intended to be used by Navy personnel in shipboard and shore based laboratories to calibrate oscilloscope. For the purposes of this specification, the Oscilloscope Calibrator shall be referred to as the OSCAL.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General Specification for," and all documents referenced therein of the issues in effect on the date of the solicitation shall form a part of this specification.

3. REQUIREMENTS

3.1 General. The OSCAL shall conform to Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased use as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The OSCAL design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power Requirements. The OSCAL shall operate from a source of 103.5 V to 126.5 V at 50 and 60 Hz ± 5% single-phase input power as specified in MIL-T-28800.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line as defined by MIL-C-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6-foot minimum length cord.

3.1.3 Dimensions and Weight. Maximum dimensions shall not exceed 19 inches in width, 10 inches in height, and 24 inches in depth. The weight shall not exceed 45 pounds.

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in

integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The OSCAL shall meet the environmental requirements for Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The OSCAL shall meet the conditions below:

	Temperature (°C)	Relative humidity (%)
Operating	10 to 30	95
	30 to 40	75
Non-operating	-40 to 70	Not Controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE03, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The OSCAL shall have a 85% or greater probability of remaining within tolerances on all specifications at the end of a 12 month period.

3.4 Maintainability. The OSCAL shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The OSCAL shall provide the following capability as specified below. Unless otherwise indicated, all specifications shall be met following a 60 minute warm-up period.

3.5.1 Output Markers. The voltage pulse markers provided in this mode of operation of the OSCAL shall be used to calibrate oscilloscope horizontal sweep time bases and other related timing requirements.

3.5.1.1 Marker Range. The output markers shall be ranged from 0.5 ns to 5 s in a 1-2-5 sequence.

3.5.1.2 Marker Uncertainty. The output marker uncertainty shall be within ± 0.0003% of reading.

3.5.1.3 Marker Amplitude. Marker amplitude shall be a minimum of:

3.5.1.3.1 Greater than or equal to 1 Vp-p into 50 ohms for a time settings of 5 s to 2 ns.

3.5.1.3.2 Greater than 350 mVp-p into 50 ohms on the 1 ns setting.

3.5.1.3.3 Greater than 100 mVp-p into 50 ohms on the 0.5 ns setting.

3.5.1.4 Variable Marker. Variable marker control shall be provided to vary the 5 s to 1 ns marker outputs a minimum of ± 9.9% of marker settings. A digital electronic display shall indicate in percent the error from the fixed marker settings and show when the dial does not indicate normal time interval marker spacing. The minimum resolution of the error display shall be 0.1%.

3.5.2 Oscilloscope Internal Calibrator Mode. This function is used to calibrate the internal calibration generator of the oscilloscope under test. The oscilloscope internal calibration generator and the OSCAL amplitude signals shall be applied to a comparator head and simultaneously displayed on the oscilloscope CRT. The OSCAL output is then varied to obtain congruent displays and the error shall be displayed on the OSCAL.

3.5.2.1 Amplitude Range. The amplitude range shall be from ± 40 (V to ± 100 V into 1 megohm, and from ± 40 (V to ± 5 V into 50 ohms in a 1-2-5 sequence.

3.5.2.2 Amplitude Uncertainty. The amplitude uncertainty shall be no greater than ± 0.25% ± 1 (V and shall apply in both fixed and variable modes.

3.5.2.3 Variable Amplitude Control. A variable amplitude control shall be provided to vary the output voltage at least ± 9.9%. A digital electronic display shall indicate in percent the voltage error of the unit under test.

3.5.2.4 Frequency Range. The OSCAL output waveform frequency shall be provided as a minimum at 10 Hz, 100 Hz, 1 kHz, and 10 kHz.

3.5.2.5 Switching. The output comparator head shall be capable of displaying either input to the head separately or be capable of repetitive switching between the two at a fixed nominal rate of between 30 Hz and 100 Hz. The switching rate shall not cause synchronization problems with the displayed waveforms.

3.5.3 Voltage Calibration Generator with Time Division. This output (volts/division) shall be used to calibrate vertical amplifier display accuracy and attenuator compensation. The 1-2-5

steps shall be supplied with multipliers of 1, 2, 3, 4, 5, 6, 8, and 10.

3.5.3.1 Amplitude Calibrator Mode. The following calibration DC and square wave (chopped DC) outputs of 10 Hz, 100 Hz, 1kHz, and 10 kHz shall be provided.

3.5.3.1.1 Amplitude Range. The output amplitude range shall be from 40 (Vp-p to 5 Vp-p into 50 ohms, and to 200 Vp-p into 1 megohm in a 1-2-5 sequence with multiplier.

3.5.3.1.2 Amplitude Uncertainty. The amplitude uncertainty shall be within ± 0.25% of reading ± 1 (V.

3.5.3.1.3 Amplitude Variable Control. An amplitude variable control shall be provided to vary the output voltage at least ± 9.9%. A digital electronic display shall indicate in percent the voltage error and show when the dial does not indicate the voltage level. The minimum resolution of the error display shall be 0.1%.

3.5.3.1.4 Polarity. The voltage waveform shall be positive from ground.

3.5.3.2 Low Distortion Pulse Output (High Impedance Output). A high amplitude pulse output shall be provided which is adjustable in fixed 1, 2, 5 amplitude steps with multipliers to provide low distortion pulses with the following specifications:

3.5.3.2.1 Amplitude Range. The amplitude range shall be from 1.2 Vp-p to 100 Vp-p into 1 megohm.

3.5.3.2.2 Rise Time. The pulse output rise time shall be less than 100 ns.

3.5.3.2.3 Aberrations. The leading edge aberrations shall be within ± 2% of peak-to-peak signal amplitude.

3.5.3.2.4 Amplitude Variable Control. An amplitude range that is continuously variable over a range of at least ± 9.9% from nominal.

3.5.3.2.5 Frequency Range. Square wave frequency ranges of 10 Hz to 100 kHz in decade steps shall be provided.

3.5.3.2.6 Polarity. The pulse output shall be a positive transition from ground.

3.5.3.2.7 Long Term Flatness. The droop or tilt of the pulse shall not be greater than ± 0.5% of pulse amplitude after 500 ns from the leading edge 50% amplitude point.

3.5.3.3 Low Distortion Pulse Output (Low Impedance Output). A low amplitude and low distortion pulse output shall be provided which is adjustable in fixed 1, 2, 5 amplitude steps with multipliers to provide low distortion pulses with the following specifications:

3.5.3.3.1 Amplitude Range. The amplitude range shall be from 20 mVp-p to 1 Vp-p into 50 ohms.

3.5.3.3.2 Rise Time. The pulse output rise time shall be less than 1.3 ns.

3.5.3.3.3 Aberrations. The leading edge aberrations shall be within ± 2% of peak-to-peak signal amplitude.

3.5.3.3.4 Amplitude Variable Control. An amplitude range that is continuously variable over a range of at least ± 9.9% from nominal.

3.5.3.3.5 Frequency Range. Square wave frequency ranges of 10 Hz to 1 MHz in decade steps shall be provided.

3.5.3.3.6 Polarity. The pulse output shall be either a positive or negative transition to ground.

3.5.3.3.7 Long Term Flatness. The droop or tilt of the pulse shall not be greater than ± 0.5% of pulse amplitude after 10 ns from the leading edge 50% amplitude point.

3.5.3.4 Fast Rise Time Pulse. The fast rise pulse shall provide a fast rise, low distortion transition used for testing wide bandwidth vertical amplifiers.

3.5.3.4.1 Fast Pulse Amplitude. A minimum of 1 Vp-p ± 5% into 50 ohms shall be provided which shall be rising from ground to + 1 V or falling from ground to - 1 V. The adjustable amplitude range shall be ± 10% into 50 ohms.

3.5.3.4.2 Fast Pulse Rise Time. The fast pulse rise time shall be less than 150 ps.

3.5.3.4.3 Aberrations. The leading edge aberrations shall be less than ± 3% peak of transition amplitude, not to exceed 4% peak-to-peak for adjacent peaks.

3.5.3.4.4 Fast Pulse Frequency. The frequency of the fast rise time pulse shall be a minimum of 100 Hz to 100 kHz in decade steps.

3.5.4 Trigger Output. External trigger outputs shall be provided for as follows:

3.5.4.1 Markers Mode. A rate marker mode for triggering the oscilloscope from 5 s to 100 ns. The trigger output shall be slaved to the marker pulses and shall remain set at 100 ns for markers faster than 100 ns. Trigger rate settings divided by 1, 10, and 100 shall be provided.

3.5.4.2 Output Amplitude. The trigger output amplitude shall be a minimum of 1 Vp into 50 ohms.

3.5.4.3 Connector. The trigger output connector shall be a type BNC mounted on the front panel of the OSCAL.

3.5.5 Current Amplitude Calibrator. The standard current shall be used to calibrate current probe accuracy through a front panel current loop.

3.5.5.1 Current Range. The OSCAL current range shall be at least from 1 mA to 100 mA in 1, 2, 5 steps with multiplier.

3.5.5.2 Multipliers. The current calibrator shall have multipliers of 1, 2, 3, 4, 5, 6, 8, and 10.

3.5.5.3 Variable Control. A current range that is continuously variable over a range of at least ± 9.9% from nominal.

3.5.5.4 Uncertainty. The OSCAL current uncertainty shall be within ± 0.25% of reading ± 2 (A.

3.5.5.5 Frequency. DC and square wave (chopped DC) 10 Hz to 1 MHz minimum in decade steps.

3.6 Operating Requirements. The OSCAL shall provide the following operating capabilities.

3.6.1 Front Panel Control Requirements. All modes and functions shall be operable using front panel controls. The locations and labeling of indicators, controls, and switches shall provide for maximum clarity and easily understood operation without reference to tables, charts, or flow diagrams.

3.6.2 Programmability. All modes and functions shall be fully remotely programmable via the IEEE-488.1 instrumentation bus. When operating the OSCAL via remote programming, all front panel controls shall be disabled, except for the on / off switch and the Remote / Local switch.

3.6.3 Error Correction. During calibration, the OSCAL shall provide the capability to accept and store corrections for all measurement deviations from nominal conditions. This correction capability shall be operational from the front panel control and over the IEEE-488 bus. The OSCAL shall be capable of changing any calibration factor or other correction data stored in memory of

the OSCAL without removal of any memory circuits or devices. The calibration constants may be changed only if a switch (not a key switch) on the rear panel is enabled. When the OSCAL is operated within its calibration period, it shall meet all the specified performance specifications without requiring the additional entry of any calibration factor or other correction data by the operator, including correction data entered by an instrument controller.

3.6.4 Local / Remote. The OSCAL shall have a local and remote operation mode. It shall be either manually or remotely programmable selectable according to paragraph 3.6.2. Manual selection shall be provided by a front panel switch. A means of indicating the operational mode shall be provided. When changing modes, all parameter values shall remain unchanged.

3.6.5 Self-Test. The self-test shall comprise two selectable levels, an operation test to determine if the instrument is operationally ready, and second level diagnostic test to diagnose and isolate faulty field replaceable modules. When the self-test function is initiated, an auto-sequenced internal operation test shall be performed. The diagnostic test shall be selectable only by deliberate operator command.

3.6.6 IEEE Interface. The OSCAL shall have an IEEE-488.1 interface connector with the following capabilities: SH1, AH1, T6, L4, SR1, RL1, DT1. Serial poll capability shall be provided.

3.6.7 Compatibility. The OSCAL shall be tested for compatibility with the IEEE-488 bus and the John Fluke model 1722A/AP instrument controller.

3.7 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.7.1 Calibration Procedure. The manual shall provide an OSCAL calibration procedure in accordance with MIL-M-38793.

3.7.2 Automated Calibration Procedure Conformance. The OSCAL, when utilized by the Navy’s automated calibration procedures in conjunction with a Fluke 1722A/AP instrument controller shall be compatible with those procedures without the loss of the performance or operational requirements of this specification or those procedures. The OSCAL shall be compatible with the Navy’s automated calibration procedures with no revision to said procedures.

3.8 Accessories. The OSCAL shall include the following:

3.8.1 One power cable in accordance with MIL-T-28800, with a minimum length of 6 feet.